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Diversification, Specialization and Health Insurance Industry Development

—An Empirical Research Based on VAR Model

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Abstract

There is a closely interactive relationship among health insurance, life insurance, property insurance, accident insurance. Based on data from January 2006 to January 2017, we use VAR model to analyze the interactive relationship among health insurance, life insurance, property insurance, accident insurance empirically by Eviews 8.0. The results show that there is a long-term equilibrium and mutual causality among health insurance, life insurance, property insurance, accident insurance. From short term perspective, there are positive effects among the four major types of insurances. In particular, the promotion of accident insurance to health insurance is the most dominant, which will provide a powerful security to the diversified and comprehensive management and professional rapid development of health insurance.

Keywords

Health Insurance, Diversification, Specialization, VAR Model

1. Introduction

With the comprehensive advancement of China's economic reform, the scale of health insurance business and the field of service have been expanding, showing a rapid growth tendency. During the "12" fifth period, premium income increased by about 3 times, reaching 241 billion yuan in 2015. As the first year of "13, fifth period", in 2016, in the first half of the year, business income is close to the year-round level, the first three quarters of the original insurance premiums of 343 billion yuan, up 87% over the same period of last year, ranking the first of all types of insurance business. On the type of product, the types and quantity of commercial health insurance is continuously rising. In 1992, all kinds of health

insurance products sold over the whole country were only more than 70, more than 300 in 2003. At present, there are nearly 100 insurance companies offering commercial health insurance products and services, in the sale of product 2200, more than 3000 records have been filed, more than doubled over 5 years ago. In the field of service, the financing of insurance industry and social management and other core functions are constantly developing. Not only providing the commercial insurance and risk management service for different people, but also through the participation and handling mode, undertaking a large number of Government commissioned business. Health insurance is basically covering all citizens and playing an active role in the development of the people's livelihood project and the construction of the medical security system. Meanwhile, there are also many new problems in the development of health insurance in China. The main performance is the acceleration of health expenditure, which leads to the heavier burden of personal medical treatment [1]. Medical expenditure is higher than the increasing income, so they lead that local economy faces potential risk. "Open source" and "throttling" dual problems occur in basic medical treatment. With the rapid development of modern medical products and services market, cross-border competition has gradually intensified. Therefore, facing the effective demand of health insurance and the importance and inevitability of its own development, it is of great significance in theory and practice to study the comprehensive management and professional development of health insurance

2. Literature Review

The Kopit [2] held that the influence of market concentration on profit should be well limited because of the bigger differentiation degree of United States health insurance product and the lower market threshold. Horgby drew [3] from theoretical analysis that if the health insurance providers are allowed to carry out diversified management, the resulting category economy will make up for the scale of the demand and can disperse social risks better. Wei Hualin etc. [4] based on the full insurance and budget constraint line, they analyze the optimal utility of health insurance selection. Wang Lu [5] analyzed the effective demand of health insurance by establishing regression model. Liu Si [6] sought the quantity relationship between social and personal expenditures even health insurance premiums based on ECM. And then they predicted the scale, space and direction of health insurance market. Zhang Zhichun etc [7] used GMM to study the developing mode of health insurance. Wu Chuangjian [8] has studied how to promote the sustainable development of health insurance policy's incentive road under the prospect theory. Wang Xiangnan [9] analyzed the relationship between market structure and performance of health insurance in China. On the basis of previous research, this paper empirically analyzes the interactive relationship of China health insurance, life insurance, property insurance and accident insurance from a diverse perspective by using the VAR model. And many

beneficial results have been got, which has certain reference value to the diversification of health insurance and the development of specialized management in China.

3. Empirical Analysis

3.1. Data Selection and Processing

Because of the slow development of China's insurance market, this paper selects monthly data of health insurance, life insurance, property insurance and accident insurance from January 2006 to January 2017 in China as samples and the data are from financial research database of Beijing Poly Data Technology Co. Ltd. The premium income of the four major types of insurance is selected as the representative index which are expressed in turn as Y, $X1$, $X2$, $X3$.

In order to avoid the intense movement of data and the influence of heteroscedasticity on the empirical analysis, firstly each sequence is logarithmically processed and the new sequence is respectively recorded as Y, $X1$, $X2$, $X3$. The line chart of Y, $X1$, $X2$, $X3$ as shown in **Figure 1**. It is easy to see that each sequence has a general trend in agreement.

3.2. Stationarity Test

In order to prevent the "false regression phenomenon" caused by nonstationary time series, the traditional VAR theory requires that each variable in the model is stable, so the stationarity test of each sequence is required prior to the establishment of the VAR model. We adopts the ADF unit root to test the stationarity of new sequence LnY, Ln$X1$, Ln$X2$, Ln$X3$ according to the trend graph of **Figure 1**. All sequences are used at the same time containing intercept and trend item test, and the maximum lag period adopts the q value which is recommended automatically by Eviews. And the value is 12. The results are shown in **Table 1**.

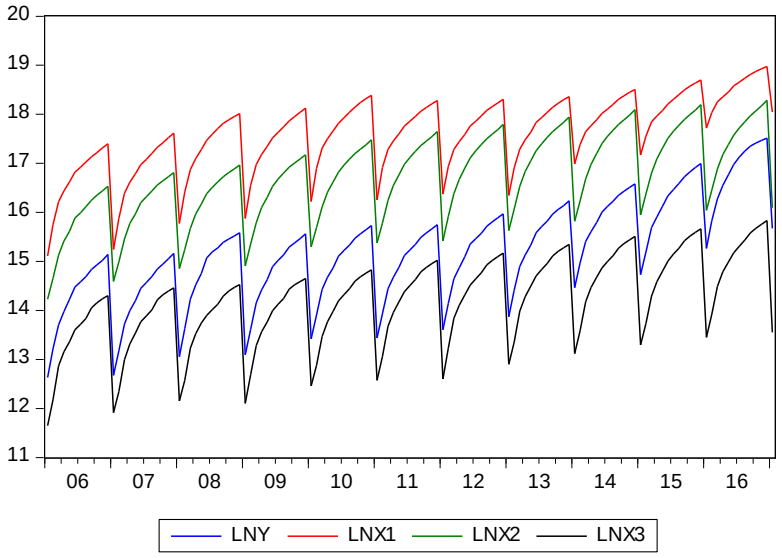

Figure 1. Sequence diagram of each insurance premium income.

Table 1. The result of ADF test for new sequences.

variable	ADF Test—P value	conclusion
LnY	0.6137	nonstationary
Ln$X1$	0.3575	nonstationary
Ln$X2$	0.9584	nonstationary
Ln$X3$	0.7018	nonstationary

According to **Table 1**, the four new sequences don't pass the ADF test. This show that LnY, Ln$X1$, Ln$X2$, Ln$X3$ all are not stationary.

Generally, the non-stationary time series need to be dealt with differential processing to make it smooth before VAR model is established. However, this will damage the information contained in the horizontal sequence. Actually, now with the development of co-integration theory, for non-stationary time series, VAR model can be established directly as long as there exists co-integration between variables [10].

3.3. Johansen Co-Integration Test

Johansen co-integration test is often used for multi-variable co-integration test. For Johansen co-integration test, first of all, we need to choose the form of co-integration equation. From **Figure 1**, there exists linear trend in the original time series, so we choose the source sequence with deterministic linear trend and the co-equation has both intercept and linear trend of the equation to carry out Johansen co-integration test. The results of the test are shown in **Table 2**.

The above results show that there exists co-integration relation among these 4 variables, so the VAR model can be established directly. Meanwhile, trace test and the largest characteristic root test indicate that there exists a co-integral vector and has a long-term equilibrium relationship. Its long-term equilibrium equation is

$$\text{Ln}Y = 29.32399 + 0.033999T + 0.548706\text{Ln}X1 - 2.195224\text{Ln}X2 + 0.758549\text{Ln}X3$$

Looking at the above-mentioned quantitative relationship, there is a positive correlation among life insurance, accident insurance and health insurance from long-term development. There is a negative correlation between property insurance and health insurance. And health insurance premiums will increase by 0.55%, 0.76% respectively if life insurance premium income and accident insurance premium income increase by 1% respectively. But when the premium income of property insurance increases 1%, health insurance premium income will reduce by 2.2%. Therefore, health insurance, the cooperative development of accident insurance and life insurance will promote the development of the whole insurance industry even the financial industry and also promote the healthy development of the national economy. On the contrary, the inhibitional effect of property insurance to health insurance is also a serious challenge for health industry. Meanwhile, the t as a local variable in the equation represents the long-term trend of health insurance premium income in China. And the value is

Table 2. The result of co-integration test for new sequences.

Hypothesized	Eigenvalue	Trace Statistic—Prob	Max-Eigen Statistic—Prob
None	0.559509	0.0000*	0.0000*
At most 1	0.164120	0.0598	0.1204
At most 2	0.100243	0.2600	0.2957
At most 3	0.045734	0.4673	0.4673

Note: Plus "*" indicates a rejection of the original hypothesis at a 5% dominance level.

0.033999 (positive number), which indicates that China's health insurance premium income will keep a steady growth trend.

3.4. Construction of VAR Model

An important problem in the VAR model is the determination of the delay order number. On the one hand, we want to make the lagging order sufficiently large enough to reflect the dynamic characteristics of the structure model when we select the lag order p. On the other hand, the larger the delay order, the more parameters need to be estimated, the less freedom degrees of the model. So it is necessary to take a comprehensive account of both the sufficient lag items and freedom degrees. The lagging order is usually determined by LR (likelihood ratio), AIC information criterion and SC criterion etc. And the results of the test are shown in Table 3.

From Table 3, we can see that more than half of the time-delay order is 6 and the lag order of the VAR model is defined as 6. The VAR (6) model is as follows:

$$\begin{pmatrix} LnY_t \\ LnX1_t \\ LnX2_t \\ LnX3_t \end{pmatrix} = \begin{pmatrix} 14.23 \\ 12.34 \\ 13.74 \\ 15.15 \end{pmatrix} + \begin{pmatrix} 1.1 & -0.75 & -1.65 & 1.34 \\ -0.1 & 0.16 & -0.92 & 0.98 \\ 0.18 & -0.8 & -1.17 & 1.83 \\ 0.12 & -0.86 & -2.11 & 2.8 \end{pmatrix} \begin{pmatrix} LnY_{t-1} \\ LnX1_{t-1} \\ LnX2_{t-1} \\ LnX3_{t-1} \end{pmatrix}$$

$$+ \begin{pmatrix} 0.74 & -0.8 & 0.72 & -0.84 \\ 0.63 & -0.52 & 0.59 & -0.79 \\ 0.65 & -0.7 & 0.66 & -0.79 \\ 0.78 & -0.79 & 0.8 & -1.02 \end{pmatrix} \begin{pmatrix} LnY_{t-2} \\ LnX1_{t-2} \\ LnX2_{t-2} \\ LnX3_{t-2} \end{pmatrix}$$

$$+ \begin{pmatrix} 1.06 & -0.78 & 0.95 & -1.16 \\ 0.84 & -0.6 & 0.71 & -0.91 \\ 1.04 & -0.78 & 1.03 & -1.23 \\ 1.33 & -0.9 & 1.21 & -1.51 \end{pmatrix} \begin{pmatrix} LnY_{t-3} \\ LnX1_{t-3} \\ LnX2_{t-3} \\ LnX3_{t-3} \end{pmatrix}$$

$$+ \begin{pmatrix} 1.72 & 0.57 & 6.68 & -8.3 \\ 1.5 & 0.51 & 5.66 & -7.09 \\ 1.61 & 0.55 & 6.44 & -7.94 \\ 1.69 & 0.6 & 7.08 & -8.67 \end{pmatrix} \begin{pmatrix} LnY_{t-4} \\ LnX1_{t-4} \\ LnX2_{t-4} \\ LnX3_{t-4} \end{pmatrix}$$

$$+\begin{pmatrix} 0.21 & -1.1 & -2.14 & 2.5 \\ 0.38 & -1 & -1.99 & 2.15 \\ 0.05 & -0.91 & -1.95 & 2.33 \\ 0.04 & -1 & -2.23 & 2.66 \end{pmatrix}\begin{pmatrix} LnY_{t-5} \\ LnX1_{t-5} \\ LnX2_{t-5} \\ LnX3_{t-5} \end{pmatrix}$$

$$+\begin{pmatrix} -1.81 & 0.82 & -0.21 & 0.72 \\ -1.46 & 0.57 & -0.24 & 0.67 \\ -1.69 & 0.86 & -1.15 & 0.52 \\ -1.86 & 0.9 & -0.25 & 0.69 \end{pmatrix}\begin{pmatrix} LnY_{t-6} \\ LnX1_{t-6} \\ LnX2_{t-6} \\ LnX3_{t-6} \end{pmatrix}$$

3.5. Adaptability Test

An adaptive test of VAR system is needed after the VAR parameter estimation. Generally, the reciprocal of the AR characteristic polynomial roots is adopted to test. The model will be stable if all inverse of the VAR model is less than 1 (That is, all inverses are in the unit circle). The adaptive test results for the VAR (6) model are shown in Figure 2.

Table 3. The result of lag order judgment of VAR model.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	−41.14209	NA	2.41e−05	0.716541	0.806582	0.753122
1	386.1595	820.6903	3.52e−08	−5.812055	−5.361851	−5.629151
2	427.0719	75.98018	2.37e−08	−6.207490	−5.397124*	−5.878263
3	449.6091	40.42401	2.14e−08	−6.311256	−5.140727	−5.835707
4	479.0960	51.01687	1.73e−08	−6.525333	−4.994641	−5.903461*
5	496.8661	29.61698	1.70e−08	−6.553431	−4.662576	−5.785236
6	513.7253	27.02811*	1.69e−08*	−6.567068*	−4.316050	−5.652550
7	528.8290	23.25500	1.73e−08	−6.552842	−3.941662	−5.492001

Note: *Represents the lag order of the selected from each column criterion.

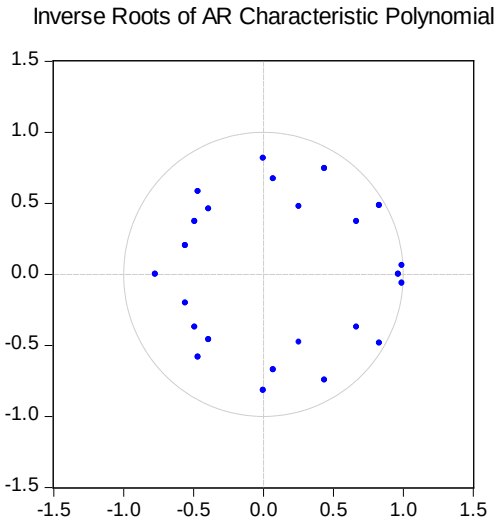

Figure 2. Adaptability test results of VAR model.

3.6. Granger Causality Test

The Granger causality test essentially checks whether a variable can be introduced into other variable equations. If a variable is affected largely by the other variables, they have a Granger Causality relationship. Therefore, we tests whether there is a significant Granger relationship among the premium income Ln$X1$ of life insurance, the premium income Ln$X2$ of property insurance, the premium income Ln$X3$ of accident insurance and the health insurance premium Ln Y based on VAR (6) model. And the results are shown in Table 4.

The results from Table 4 show that Y, $X1$, $X2$, $X3$ each other has causal relations under a dominance level of 1%. Namely health insurance, life insurance, property insurance, accident insurance individual influences each other. And any three insurance industries also have a dominant impact on other insurance. This is consistent with the aforementioned studies. This is to say that life insurance, property insurance, accident insurance is an important engine of health insurance development.

3.7. Pulse Response Analysis

In the practical application, the VAR model is a non-theoretical model, which has to make any prior restrictions on variables. So we often do not analyze the impact of a variable on the other variable. Instead, we analyze the changes of an

Table 4. The result of granger causality test.

Excluded	Hypothesized	Chi-sq	df	Prob.
Ln Y	Ln$X1$ can't Granger cause Ln Y	27.03424	6	0.0001
	Ln$X2$ can't Granger cause Ln Y	59.26139	6	0.0000
	Ln$X3$ can't Granger cause Ln Y	66.24636	6	0.0000
	Ln$X1$, Ln$X2$, Ln$X3$ can't simultaneously Granger cause Ln Y	95.60278	18	0.0000
Ln$X1$	Ln Y can't Granger cause Ln$X1$	53.28705	6	0.0000
	Ln$X2$ can't Granger cause Ln$X1$	60.26542	6	0.0000
	Ln$X3$ can't Granger cause Ln$X1$	69.77350	6	0.0000
	Ln Y, Ln$X2$, Ln$X3$ can't simultaneously Granger cause Ln$X1$	88.97540	18	0.0000
Ln$X2$	Ln Y can't Granger cause Ln$X2$	42.38276	6	0.0000
	Ln$X1$ can't Granger cause Ln$X2$	22.13762	6	0.0011
	Ln$X3$ can't Granger cause Ln$X2$	59.30668	6	0.0000
	Ln Y, Ln$X1$, Ln$X3$ can't simultaneously Granger cause Ln$X2$	80.24209	18	0.0000
Ln$X3$	Ln Y can't Granger cause Ln$X3$	47.12063	6	0.0000
	Ln$X1$ can't Granger cause Ln$X3$	24.34347	6	0.0005
	Ln$X2$ can't Granger cause Ln$X3$	57.75526	6	0.0000
	Ln Y, Ln$X1$, Ln$X2$ can't simultaneously Granger cause Ln$X3$	83.92103	18	0.0000

error term or a certain impact of the model subjected to the dynamic impact of the system, which can be described by the impulse response function. We adopts impulse response function to analyze the impact of health insurance, life insurance, property insurance and accident insurance own needs' change on themselves. Namely a positive impact separately is given for health insurance premium income, life insurance premium income, insurance premium income and accident premium income. Using generalized impulse method to get the premium response function figure of each insurance premium income (Figure 3).

By analyzing Figure 3, we can know that, in the short term, a standard deviation from health insurance premium income against life insurance, property insurance, accident insurance's has a strong response immediately. Income added value is roughly the same, about 0.5, but the impact of the time is not long, to phase 3 has returned to the original level. After a slight decline, it is basically stable, which shows the life insurance industry, property insurance industry, accident insurance industry is subjected to an impact of external conditions. Through the market to pass to the health insurance industry and make the health insurance industry a co-impact, and this impact plays a dominant active role. Meanwhile, after the current issue of health insurance premium income is processing a positive impact, life insurance premium income, property insurance premium income and accident insurance premium income. And income itself will fluctuate violently during the first 3 period and begin to stabilize after the 3 period, which shows that a certain impact of the health insurance industry will also give life insurance industry, property insurance industry, accident insurance industry and its own impact on the same, which is to produce a pull.

3.8. Variance Decomposition

Variance decomposition further evaluates the importance of evaluating the

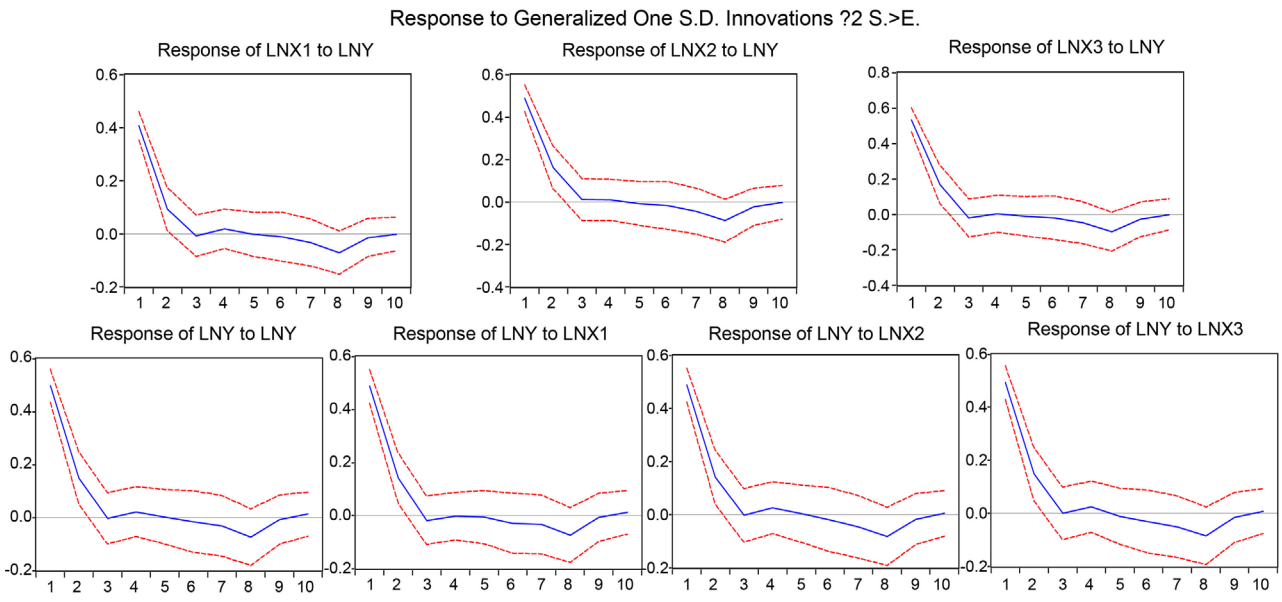

Figure 3. Premium response figure of VAR model.

impact of different structures by analyzing the contribution rate of each structural impact to endogenous variable variation, and gives the relatively important information of each random disturbance affected by the variables in the VAR model. We analyzes the contribution of life insurance industry, property insurance industry and accident insurance industry to health insurance industry by using the basic analysis of variance analysis, and the results of the analysis are shown in Figure 4.

From Figure 4, we can see that in a short period, the life insurance industry, the property insurance and accident insurance industry contributes a maximum of 5%, 9%, 38% respectively for the health insurance industry, and then levels off smoothly.

4. Conclusions and Suggestions

Through the study of the interaction among China's health insurance, life insurance, property insurance, accident insurance, we can get the following conclusions: 1) From the Granger causality test, we find that health insurance, life insurance, property insurance and accident insurance have reciprocal causation and they can mutual influence and interact each other. 2) According to the Johansen co-integration test, health insurance and life insurance, property insurance and accident insurance have a long-term equilibrium relationship. And the development of life insurance and accident insurance promotes the health insurance industry. While property insurance has a negative effect on health insurance. But overall, China's health insurance development is still in a stable growth situation. 3) Based on the dynamic analysis results of impulse response and variance decomposition, in the short term, life insurance, property insurance, accident insurance have positive effect on health insurance. And the health insurance also has positive effect on life insurance, property insurance and accident insurance, which further explains the importance of health insurance to the whole insurance industry and the necessity of research. Meanwhile, the effect of health insurance on its own promotion is also extremely dominant, which also provides effective demand for the specialized management of health insurance.

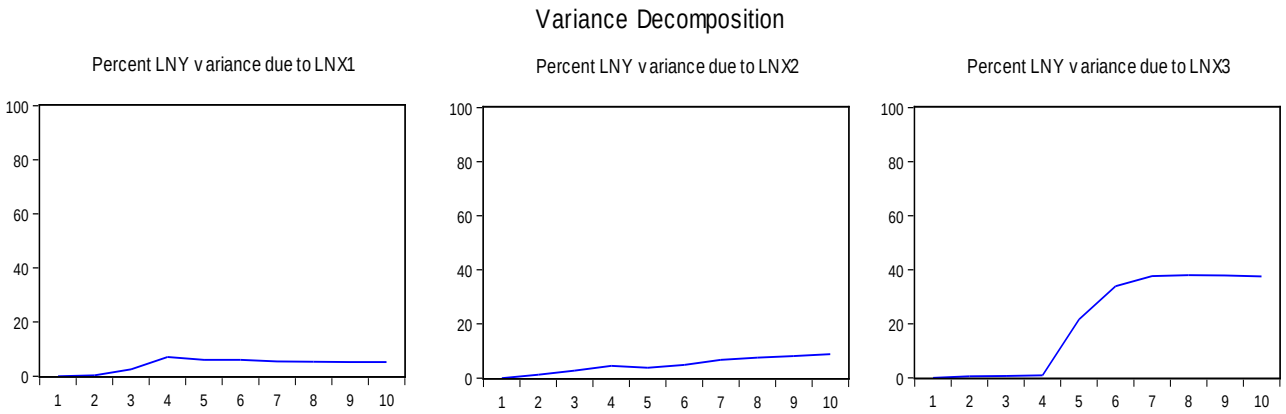

Figure 4. Variance decomposition of health insurance industry.

Among the promotion of life insurance, property insurance, accident insurance, the contribution of accident insurance to health insurance is the greatest, followed by property insurance and life insurance.

Above all, strengthening the comprehensive management of health insurance and life insurance, property insurance and accident insurance, making the health insurance industry develop diversifiedly will further demonstrate the important role of health insurance in the whole insurance industry and the financial industry. Meanwhile, under the background of multiple health insurance, totally creating a specialization of health insurance product will also promote the rapid development of health insurance industry.

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